

# XMCD measurement of the induced spin polarization of Cu

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## INTRODUCTION

The understanding of interface effects in magnetic multilayers is of great importance but the measurement of these effects is very demanding due to their in general small size. XMCD spectroscopy and microscopy using electron yield detection is an ideal tool to study surfaces and interfaces because of its high surface sensitivity. Here we present XMCD spectroscopy results on a “benchmark” sample measured at the new, elliptically polarizing undulator beamline 4.0.2 at the Advanced Light Source. The studied sample is a Co/Cu multilayer, in which the Cu interface spins are polarized by magnetic exchange with the ferromagnetic moments of the Co layer [1]. This experiment demonstrates our ability of measuring small magnetic effects, which are on the order of 0.1 %, corresponding to less of a monolayer of ferromagnetically aligned interface spins.

## EXPERIMENT

The sample was a multilayer of the form 20x { 1 nm CoFe(90/10) / 1.3 nm Cu } grown on Si. A buffer layer of 5 nm Ru and a cap layer of 1.5 nm Ru prevented the oxidation of the sample. The XMCD spectra were measured in the absorption mode by measuring the sample current (typical sample current was 1 nA). The sample was mounted in the gap of an electromagnet which can switch a magnetic field up to 3000 Oe with 1 Hz. The magnetic field was applied along the polarization vector of the circularly polarized light. The sample was mounted in grazing incidence geometry such that the in-plane moment is measured.

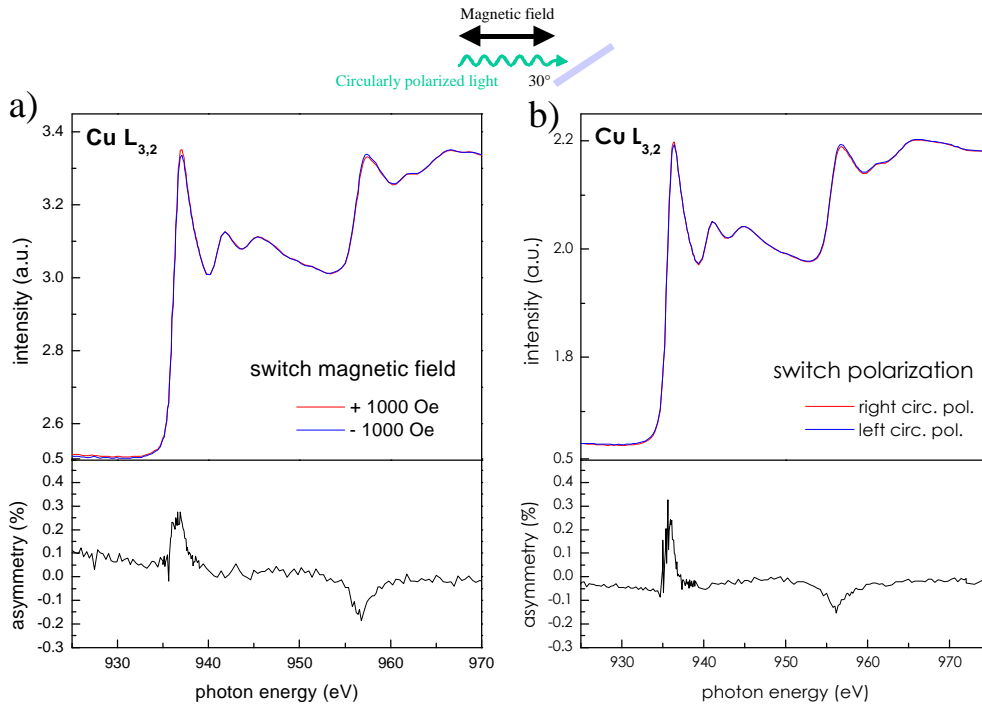


Figure 1. XMCD spectra of the Cu  $L_{3,2}$  edge measured by switching the magnetic field a) and by switching the polarization b) at each energy point. An energy shift of 26 eV between the two spectra measured with opposite x-ray polarization has been corrected for. The measuring geometry is shown at the top.

Figure 1a shows the absorption spectrum and the XMCD asymmetry of the Cu L<sub>3,2</sub> edge, which were measured in an applied field. The field was switched at each energy point between +1000 Oe and -1000 Oe while the polarization of the X-ray was fixed (degree of polarization was 64%). The spectra match perfectly after scaling by only about 1% with a noise level below 0.1%. The observed asymmetry is in accordance with data from the literature [1]. An even smaller noise level has been achieved when the polarization of the X-ray was switched at each energy point and the magnetic field was fixed at 1000 Oe (see Figure 1b). An energy shift of 26 meV related with the polarization switching was found and has been corrected for.

These measurement provide valuable information on the performance of the new elliptically polarizing undulator beamline 4.0.2 and the used experimental setup, giving us confidence in our ability to measure small effects in new, less well-known systems.

## REFERENCES

- [1] G.A. Held, M.G. Samant, J. Stoehr, S.S.P. Parkin, B.D. Hermsmeier, M. van Schilfgaarde, and R. Nakajima, *Zeitschrift fur Physik B (Condensed Matter)* **100**(3), 335 (1996).
- [2] This was the largest observed energy shift between left and right circularly polarized light. Typically, the energy shift is about 5 meV.

This work was supported by the Division of Chemical Sciences (SSRL) and the Division of Materials Science (ALS) of the Office of Basic Energy Sciences of the U.S. Department of Energy.

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